<u>In the specification</u>:

Please amend the specification as follows:

Please amend the paragraph on page 2, from lines 15 through 22, as follows:

According to the above-described methods, it becomes apparent that <u>a</u> large ~~amounts~~ <u>amount</u> of ~~nitrogen~~ <u>hydrogen</u> produced by thermally decomposing ammonia [[are]] <u>is</u> automatically added into a silicon nitride film. Further, according to the ~~above referenced~~ <u>above-described method of</u> (2), it is recognized that the silicon active layer is damaged by influence of high-speed ions and defects in crystal are caused. Dangling bonds of silicon in the silicon nitride film caused by the crystal defects operate as carrier traps and<u>,</u> therefore, ~~therefore~~ it is necessary to inactivate the dangling bonds. In order to realize the inactivation, it is necessary to intentionally dope ~~nitrogen~~ <u>hydrogen</u> and couple ~~nitrogen~~ <u>hydrogen</u> to the dangling bonds of silicon.

Please amend the paragraph on page 3, from lines 1 through 8, as follows:

In sum, the reason of poor heat resistance of the conventional silicon nitride film or silicon oxi-nitride film, is nothing but inclusion of a large amount of hydrogen in the film. Hence, it has been found that the poor heat resistance indicated conventionally can be overcome by using a silicon nitride film which does not include hydrogen and which does not include defects caused by damage by ions. That is, in order to subject the gate insulator to high <u>function</u> ~~f. unction~~ formation, there is used a silicon nitride film the specific inductive capacity of which is approximately twice as much as that of silicon oxide, which is thermally stable and is not provided with <u>a</u> Si-H bond at least as a portion of a gate insulator.

Please amend the paragraph on page 3, from lines 14 through 19, as follows:

Further, according to another aspect of the invention, there is provided a semiconductor device which is a semiconductor device constituting an active layer by a single crystal or polycrystal silicon semiconductor and [[.]] having a gate electrode on the active layer by interposing a gate insulator, wherein the gate insulating film is constituted by a multilayered structure film including at least one layer of a silicon nitride film which does not include a chemical bond of hydrogen atoms and silicon atoms.

Please amend the paragraph on page 4, from lines 10 through 25, as follows:

Further, according to another aspect of the invention, there is provided a semiconductor device which is a semiconductor device constituting an active layer by a single crystal or polycrystal silicon semiconductor and [[.]] having a gate electrode on the active layer by interposing a gate insulator, wherein the gate insulator is constituted by a multilayered structure film including at least one layer of a silicon oxi-nitride film which includes a chemical bond of oxygen atoms and silicon atoms and does not include a chemical bond of hydrogen atoms and silicon atoms and at least one layer of a ferroelectric film. Further, according to another aspect of the invention, there is provided the semiconductor apparatus, wherein a film other than the silicon oxi-nitride film in the multilayered structure film is formed by a thin film comprising a metal oxide. Further, according to another aspect of the invention, there is provided a process of producing a semiconductor device which is a process of producing a semiconductor device having a step of constituting an active layer by a single crystal or polycrystal silicon semiconductor substrate and forming a gate electrode on the active layer by interposing a gate insulator, wherein by using a nitrogen radical in a nitrogen plasma as a major active species of nitridation, the substrate is nitrided and the gate insulator is formed.

Please amend the paragraph on page 6, from lines 7 through 22, as follows:

Fig. 2 shows an outline view of an apparatus used for forming a silicon nitride film which does not include hydrogen and does not include carrier traps caused by defects on a silicon semiconductor. After introducing a silicon substrate 13 for forming a silicon nitride film into an ultra high vacuum vessel 9 made of stainless steel, the vacuum vessel 9 is exhausted up to 1 x 10^{-7} to thereby minimize influence of moisture remaining in a nitridation process. After previously forming a diffusion layer on the silicon substrate 13, a surface thereof is cleaned by a chemical solution, thereafter subjected to a pretreatment by hydrofluoric acid diluted to 1/50 by de-ionized water to thereby remove native oxide formed on the surface of the substrate and form a hydrogen-adsorbed layer referred to as hydrogen termination and prevent the surface from being reoxidized. The [[20]] vacuum vessel 9 is installed with a nitrogen radical generating apparatus (radical gun) 11 having a small plasma chamber made of PBN (Pyrolytic Boron Nitride) or made of quartz, and nitrogen radical flux 16 generated therefrom is irradiated to silicon substrate crystal to thereby subject the surface of the substrate to direct nitridation. Further, in the drawing, numeral 12 designates a high

purity nitrogen tank for generating nitrogen radicals, numeral 17 designates a substrate rotating mechanism and numeral 18 designates a substrate susceptor.

Please amend the paragraph on page 6, from lines 23 through 34, as follows:

Fig. 3 shows a schematic view of the nitrogen radical generating apparatus. Nitrogen having a purity of 100% is made to flow to a plasma chamber 23 made of PBN or made of quartz via a nitrogen gas supply pipe 20 and RF (Radio Frequency) is applied from an outside power source to an RF induction coil 22 installed ~~at a~~ surrounding [[of]] the plasma chamber to thereby generate nitrogen plasma. One side of the plasma chamber 23 communicates with the ultra high vacuum vessel of Fig. 2 via small openings 25 and nitrogen radicals generated in the plasma chamber are introduced into the ultra high vacuum vessel via the holes only by pressure difference between the plasma chamber and the ultra high vacuum vessel as nitrogen radical flux <u>16</u> [[26]]. The plasma does not leak into the ultra high vacuum vessel and, therefore, a probability that high-speed ions generated in the plasma reach the silicon substrate crystal and damage the silicon substrate crystal by the ions [[,]] is far [[:]]smaller than that of the conventional plasma nitridation process.

Please amend the paragraph on page 7, from lines 17 through 22, as follows:

Fig. 4 shows a spectrum of plasma emission in the plasma chamber made of PBN or made of <u>quartz</u> ~~quarts~~. It is known from the spectrum that emission in correspondence with N_2^+ ion is at an almost negligible level and strong emission in correspondence with atomic nitrogen radical (N^*) and emission in correspondence with N2 radical (N_2^*) constitute major active species. By irradiating the radicals (N^*, N_2^*) to the silicon substrate crystal as shown by Fig. 1, a silicon nitride film is formed.

Please amend the paragraph on page 9, from lines 9 through 16, as follows:

Fig. 8 shows a third embodiment according to the invention. Similar to Embodiment 1, after forming the active layer of the transistor, a silicon nitride film having a film thickness of about 0.8 nm is formed on the active layer by a procedure the same as that of Embodiment 1. Thereafter, Al is formed by 3 nm by an evaporation method and Al is subjected to an oxidizing heat treatment at 650°C for 30 minutes in an oxygen atmosphere to thereby constitute a multilayered structure film of an amorphous <u>Al_2O_3</u> ~~Ai_2O_3~~ thin film 29 and a silicon oxi-nitride film 28. Thereafter, a field effect transistor is produced by steps the same as those of Embodiment 1.

Please amend the paragraph on page 9, from lines 18 through 25, as follows:

Fig. 9 shows a fourth embodiment according to the invention. Similar to Embodiment 1, after forming the active layer of the transistor, a silicon nitride film having a film thickness of about 1.8 nm is formed on the active layer by a procedure the same as that of Embodiment 1. Thereafter, Ti is formed by 5 nm by an evaporation method and Ti is subjected to an oxidizing heat treatment at 650°C for 30 minutes in an oxygen atmosphere to thereby constitute a multilayered structure film of a titanium oxide (TiO_2) thin film 30 and a silicon oxi-nitride film <u>28</u>. Thereafter, a field effect transistor is [[20]] produced by steps the same as those of Embodiment 1.

Please amend the paragraph bridging pages 9 and 10, from line 27 on page 9 through line 7 on page 10, as follows:

Fig. 10 shows a fifth embodiment according to the invention. Similar to Embodiment 1, after forming the active layer of the transistor, a silicon nitride film having a field thickness of about 1.8 nm is formed on the active layer by a procedure the same as that of Embodiment 1. Thereafter, a polycrystal $SrBi_2Ta_2O_9$ ferroelectric [[:]] oxide film is formed by 120 nm by a sol-gel method to thereby constitute a multilayered structure film of <u>a</u> [[an]] $SrBi_2Ta_2O_9$ ferroelectric thin film 32 and a silicon oxi-nitride film 31. Thereafter, a field effect transistor is produced by steps the same as those of Embodiment 1. Further, in order to crystallize the $SrBi_2Ta_2O_9$ ferroelectric thin film 32, the $SrBi_2Ta_2O_9$ ferroelectric thin film 32 is subjected to an oxidizing heat treatment at 750°C for 30 minutes [[10]] in an oxygen atmosphere.

Please amend the paragraph bridging pages 10 and 11, from line 13 on page 10 through line 6 on page 11, as follows:

The silicon nitride film is formed by dissociating the hydrogen termination, thereafter returning the substrate temperature to 30°C and nitriding the substrate for 15 minutes and thereafter annealing the substrate at 900°C for 60 minutes in pure nitrogen. Interface state density of the silicon substrate crystal and silicon nitride calculated by <u>the</u> Terman method from the capacitance characteristic of Fig. 11 [[,]] is 3.5 x $10^{11}cm^{-2}eV^{-1}$, and an extremely excellent characteristic is achieved, although the post heat treatment at <u>a</u> high temperature of 900°C is carried out. This is a structure in which the silicon nitride film, produced by the above-described method according to the invention, does not include hydrogen and defects,

showing that chemical bond of hydrogen and silicon which is to be dissociated at a temperature of 550°C or higher [[,]] does not exist in the film, and there is not brought about a phenomenon of reactivating traps which have been inactivated by the chemical bond of hydrogen and silicon by the post heat treatment and, therefore, the excellent characteristic is maintained regardless of the heat treatment at high temperature. Therefore, according to the field effect transistor of the invention, there can freely be adopted a step of producing a capacitor having a high dielectric constant, a characteristic of which remains unchanged at any post step of high temperature of LSI in an oxygen atmosphere at high temperature. Further, although the specific inductive capacity of silicon nitride is larger than that of [[o f]] silicon oxide, the band gap is small and leakage current in the thin film formation thereof can be reduced by combining with a silicon oxide film. Therefore, a laminated structure of a silicon oxide film and a silicon nitride film is advantageous as a gate insulator as shown by Embodiment 2 at an extremity of thinning the gate insulating film. When the present invention is used, the multilayered structure film having high quality as shown by Embodiment 2 can easily be realized since the film is provided with a high resistance against heat treatment in an oxidizing atmosphere. Further, by making full use of the high oxidation resistance, for example, the multilayered structure of the oxide thin film having the high dielectric constant and the silicon oxi-nitride film as shown by Embodiment 3 and Embodiment 4, or the multilayered structure of the oxide polycrystal thin film having high permittivity and silicon oxi-nitride shown by Embodiment 5, can be produced for the gate insulator.

Please amend the paragraphs on page 11, from lines 7 through 18, as follows:

Fig. 13 shows a capacitance versus voltage characteristic measured between a gate electrode and a drain electrode of a [[an]] MIS type field effect transistor constituting a gate insulator by the $A1_2O_3/Si_3N_4$ laminated insulator produced by Embodiment 3. Further, Fig. 14 shows a current versus voltage characteristic measured between the gate electrode and the drain electrode of the same MIS type field effect transistor. An effective thickness of an oxide film (a thickness of an SiO_2 film necessary for realizing the same capacitance density by the MIS structure), calculated from a maximum capacitance value on an accumulated side of Fig. 13, has been 2.66 nm.

Fig. 15 shows a current versus voltage characteristic measured between a gate electrode and a drain electrode of a [[an]] MIS type field effect transistor constituting a gate

insulator by a film of a single layer of Si_3N_4 having substantially the same effective thickness ~~(2.67 nm)of~~ (2.67 nm) of an oxide film for comparison.

Please amend the paragraph on page 11, from lines 24 through 33, as follows:

Meanwhile, according to the conventional laminated layer structure of the silicon nitride film and Al_2O_3, the silicon nitride film is deteriorated in the heat treatment of forming Al_2O_3 and the excellent capacitance characteristic as shown by Fig. 13 is not shown. Further, according to the single layer structure of Al_2O_3, a silicon single crystal of the substrate is oxidized in forming Al_2O_3 to thereby form a low dielectric constant layer and, therefore, it is difficult to realize a capacitance density higher than that of an element having the structure shown in Embodiment 3. By using the structure of Embodiment 3, while maintaining an excellent interface characteristic on the silicon single crystal of the substrate, high capacitance density and insulating performance, which have not been ~~being~~ achieved conventionally, can be realized.